

## **Management Guidelines for Stonewall Trees**



**GREENING, LANDSCAPE AND TREE MANAGEMENT SECTION  
DEVELOPMENT BUREAU**

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## 1.0 Introduction

1.1 Stonewall trees are unique landscape, ecological and amenity features in our city. Since the founding of the city in the 1840s, there has been acute demand of land for urban growth. To overcome the hilly terrain with limited flat land for development, stone retaining walls of various types were built by traditional Chinese masonry techniques to provide horizontal platforms and stabilise disturbed terrain. With the sub-tropical climate, the presence of plant species usually *Ficus* spp. with strangler growing habit, joints between the stonewall blocks, the soil behind the walls and ground water seepage have permitted plant growth and stonewall trees have established on vertical surfaces on the stone retaining walls. These unique trees enrich the urban ecology and offer greenery to ameliorate the congested urban environment in Hong Kong.

1.2 Few cities in the world have so many stone retaining walls with spontaneous vegetation in an urban setting (Jim, 2010). The traditional craft in masonry wall construction is no longer present and there is no new stone wall constructed by traditional craftsmanship thus making stonewall trees unique heritage that deserve and require proper management.

1.3 Tree species with strangler growing habit are able to secure a strong grip on vertical wall surface and adapt to such harsh growing environment. These include *Ficus microcarpa*, *F. subpisocarpa* (*F. superba* var. *japonica*), *F. hispida* and *F. virens* which constitute the majority of stonewall tree species as they can fit into the vertical habitat for successful establishment on stone walls to become sizable landscape features. Other common species include *Celtis sinensis* and *Broussonetia papyrifera* (Jim, 1998).

1.4 Wall trees growing on stone walls are natural-cum-cultural assets and special preservation measures are required. The “Management Guidelines for Stonewall Trees” (Guidelines) serve as a reference for tree management

departments in the management of stonewall trees with a view to promoting their health and structure, minimising their risk of failure and optimising their longevity.

## **2.0 Definition of Stonewall Trees**

2.1 A stonewall tree is defined as a tree growing on a stone retaining wall satisfying the following criteria.

### **a) Wall Trees**

*“A wall tree should have most of its roots spreading on or penetrating through the wall face, and with the trunk base situated within the confines of a wall. A tree overhanging above a wall but not physically attached to it, and a tree with trunk base and most roots located outside a wall’s boundaries, did not qualify.”*  
(Jim, 1998).

### **b) Stone Retaining Walls**

Stone retaining walls consist of rubble walls composed of stones of regular or irregular size and shape and tied face walls with well shaped blocks. Free-standing walls, concrete walls or concrete walls with a stone veneer are excluded. Maintenance departments should check with the Geotechnical Engineering Office (GEO) to verify the structure of stone retaining walls if in doubt.

## **3.0 Growing Habit of Stonewall Trees**

3.1 Geotechnical works relating to the stability of stone walls are not covered in the Guidelines. Reference should be made to “Geotechnical Manual for Slopes”, “Technical Guidelines on Landscape Treatment for Slopes”, “GEO Report No. 257 – Study on Masonry Walls with Trees” and other relevant documents published by Civil Engineering and Development Department.

Stabilisation treatment of walls, if required, should be sympathetic to growth of trees, and less damaging method, e.g. recessed soil nail installation, should be adopted.

3.2 Stone retaining walls provide vertical growing environment for establishment of stonewall trees. Seeds of stonewall tree species are brought to wall surfaces by frugivorous birds or bats. Relying on limited moisture available on the wall surfaces, these seeds germinate and extend their roots to explore openings or joints on stone walls and penetrate through the walls to secure their footings and absorb water and nutrients from the aft-soil (i.e. soil behind retaining walls) to sustain their growth. The ecology of stone walls is unique and where stability of the walls is not affected, small plants (e.g. saplings, climbers, ferns, native herbaceous) should be kept intact.

3.3 Roots developed on the wall surfaces also extend their colonies by sending absorbing roots to reach the soil at toe or crest of the walls to capture more water and nutrients for growth. The surface roots also fuse together at intersections to form a distinctive root network enhancing the grip on the walls. For species with aerial roots, these roots provide additional support to improve stability of stonewall trees when lignified, particularly if they can reach the soil to become prop-like supports.



**Photo No. 1** – Distinctive root network on retaining wall surface

#### **4.0 Review of Stonewall Tree Failure Cases**

4.1 Based on available tree failure records from the maintenance departments, it is found that the main mode of failure associated with stonewall trees is uprooting during adverse weather conditions, e.g. typhoons. Most of the tree failure cases did not involve damage to the stone retaining walls and only a few cases caused localised damage.

4.2 The tree failure cases involve detachment of the roots from the wall surfaces and breakage of the roots penetrated into the walls on the tension side and rupture of the surface roots near the trunk base on the compression side. In general, it is observed that the fallen stonewall trees had only several root ingress points on the walls but the strength of root anchorage could afford establishment of sizable stonewall trees. Although the root anchorage was strong, failure would occur when excessive static and wind loads were transferred from the stems and canopies during adverse weather conditions.

#### **5.0 Management Strategies of Stonewall Trees**

5.1 The stability of trees on stone walls depends on the static and wind loads on the trunk, branches and crown as well as the strength of root anchorage (Chan, 2000). The management strategies of stonewall trees are formulated to focus on the integrity of the tree structure and root anchorage to reduce the risk of tree failure and promote tree health.

5.2 The key management strategies are:

- ◆ to maintain a balanced crown architecture and branch structure which enhance stability; and
- ◆ to improve root anchorage and strengthen support.

## **6.0 Inspection of Stonewall Trees**

6.1 Regular tree inspection is essential to monitor the tree condition and identify the required maintenance measures. Inspection should be conducted by staff with relevant training and work experience.

6.2 Periodic inspection should be conducted to suit the maintenance requirements and in line with tree risk assessment requirements of the Tree Management Office (TMO). Supplementary inspection after inclement weather to identify the extent of damage and need of remedial works is required. Inspection frequency should be increased when the stonewall trees require close monitoring due to health or structural concerns.

6.3 Thorough inspection of the entire stonewall tree and its surroundings, with particular focus on the following aspects, in line with the management strategies is required. These include, but are not limited to, the identification of:

- ◆ structural defects, such as broken or dead branches, decay, cavities, splits, cracks, weak attachments, included bark, cross branching, hangers and deformed growth requiring remedial treatment;
- ◆ overgrown, weak and defective branches, scaffold limbs with poor taper requiring end weight reduction;
- ◆ the need of selective thinning of epicormic growth to improve branch structure;
- ◆ serious leaning or imbalance crown requiring pruning to rectify the form;
- ◆ the need of pruning to maintain a reasonable crown size and balanced architecture as well as branch structure taking into account the strength of

- root anchorage to enhance stability;
- ◆ detachment of root anchorage and damage or decay of roots attached to the stone retaining wall, particularly those surface roots with visible entry points to the stone wall;
- ◆ aerial roots requiring guiding to provide potential lignified support;
- ◆ symptoms and signs of plant disorders such as fungal fruiting body and termite trails;
- ◆ adequacy of clearance to traffic and adjacent property;
- ◆ the need for provision or adjustment of installed tree support systems;
- ◆ damage or displacement of masonry blocks on the stone retaining wall requiring referral to a geotechnical engineer for follow up checking;
- ◆ recent changes to its surroundings such as trenches, grade changes, compaction, construction and demolition activities which may weaken root anchorage and increase exposure of the tree to wind;
- ◆ opportunities for providing enlarged planting areas at toe or crest of the stone retaining wall; and
- ◆ opportunities for guiding roots to soil.

6.4 Further investigation of the structural conditions by resistographic and tomographic instruments should be conducted if required. Monitoring of movement on stone walls should be considered if stability of the stone walls is a concern upon inspection by a geotechnical engineer.

## **7.0 Maintenance of Stonewall Trees**

7.1 Maintenance operations should be carried out in accordance with the recommendations arising from the inspections. The operations should be



carried out by trained personnel under supervision of trained and experienced supervisors with good knowledge in respect of the care of stonewall trees to ensure that maintenance operations can be carried out properly and safely in accordance with the proper arboricultural practices.

7.2 The following paragraphs outline the key measures in the maintenance of stonewall trees. These include preventive measures to promote tree health and structure, and remedial treatments of tree defects to reduce potential risks.

### **7.3 Pruning**

7.3.1 Pruning should be carried out in accordance with the proper pruning practices promulgated by the TMO, for example, “General Guidelines on Tree Pruning” in the website <http://www.trees.gov.hk> and reference can be made to the international standards and best practices such as the standards promulgated by American National Standards Institute, the British Standards Institution, the International Society of Arboriculture, and Arboricultural Association. Prune only when necessary. The extent of pruning and size of pruning wounds should be minimised as far as practicable to any reduce stress to the stonewall trees and the vulnerability to pest and disease attack from pruning wounds. It is recommended that no more than 25% of the live crown, if justified, should be pruned in any one year. Large pruning wounds and removal of large branches should be avoided. Malpractices such as topping, lion tailing, excessive pruning should not be performed. The amount, location and method of pruning should be prescribed by a trained tree management professional and implemented by a worker/contractor with appropriate skills.

### 7.3.2 Remove Defective Branches

Dead, diseased or broken branches should be removed as appropriate to address structural and health concerns. Defective branches with weakened mechanical strength and other defects due to advanced decay, cavity formation, and crack development at critical junctures and cross branching should be removed. Stubs should also be removed in order to avoid decay spreading to the parent stems or branches.

### 7.3.3 Reduce Excessive Branch End Weight

An appropriate amount of end weight should be removed where necessary to reduce the load and abate the risk of failure under the following circumstances: overgrown branches and poor taper, branches suffering from decay or cavity at critical points with reduced load-bearing capacity, truncated branches due to improper heading cut, or long, heavy and upright epicormic branches developed at or near the cut wounds with decay.

### 7.3.4 Rectify Imbalance Tree Crown

Low leaning angle is common in stonewall trees because of the vertical habitat and the presence of physical obstacles at the back of the walls. The natural leaning and “imbalanced” crown of stonewall trees to suit their growing habit against a vertical wall should not be directly compared to that of trees growing on ground. As a reference for stonewall trees, due to their special habitat, tilting reaching beyond 40° would be considered as heavy lean that deserve close attention (Jim, 2012). Reduction pruning to shorten severe leaning branches should be considered in order to rectify the imbalanced tree crown and improve stability if necessary.

### 7.3.5 Maintain Optimal Size of Tree Crown

Static load and wind load to stonewall trees are proportional to the frontal area of tree crown. For stonewall trees with large tree crowns but limited root attachment and support, the force transferring from the crown to the root anchorage during windy conditions is large and the risk of uprooting of stonewall trees would increase, especially if the stonewall trees are located at exposed locations (Chan, 2000). Reduction pruning should be performed to reduce the size of tree crown when necessary to avoid excessive loading to root anchorage.

### 7.3.6 Provide Adequate Clearance from Road Traffic and Properties

7.3.6.1 Mechanical damage by moving vehicles can cause severe impacts to stonewall trees protruding from stone retaining walls along the roadside. A stonewall tree may fail if hit by a heavy vehicle. Low and overhanging branches affecting traffic flow should be appropriately pruned to provide adequate clearance. In general, a head room clearance of 5.5m is required for public roads. Warning signs or markings should be provided, if required, for tree parts which are close to traffic corridors.

7.3.6.2 For branches that are very close to properties or structures, reduction pruning to provide adequate clearance should be carried out to prevent branches from hitting and damaging adjacent properties in windy conditions.

## 7.4 Utilise Aerial Roots as Lignified Support

7.4.1 Stonewall tree species with aerial roots that capture water and nutrients from the surroundings have the potential to develop and provide additional

lignified support. Therefore, aerial roots should be retained whenever practicable and trimming of them should be the last resort.

7.4.2 The best treatment is to allow aerial roots to reach the soil at ground to become upright lignified support for stonewall trees. If no soil is located underneath the aerial roots, opening up of paving to allow aerial roots to anchor at the ground with soil should be considered. At the same time, it would be necessary to consider the adequate strength of the whole root system to support the increased canopy size and the proportionate growth of the aerial roots to form a prop-like support. Guide tubes or ushering ropes can be used to facilitate aerial roots to reach the ground/soil quickly. If these measures are not feasible, aerial roots can be guided and ushered along branches by ropes made of degradable materials to locations for landing and anchorage. Where soil is not available in the vicinity, aerial roots can be ushered along branches to the main stems or scaffold branches to form lignified support to reinforce the branch structure. Aerial roots should be retained whenever practicable. Trimming, cutting or twisting around branches should not be allowed. Keeping joints of masonry walls unsealed is important for the root growth.



**Photo No. 2** – Lignified aerial roots forming natural prop-like supports to improve stability of stonewall tree



**Photo No. 3** – An example of guiding aerial roots by plastic tubes filled with planting medium



**Photo No. 4** – Aerial roots ushered along branches to the main stems or scaffold branches to form lignified support



**Photo No. 5** – Aerial roots forming lignified support to strength the branch support structure

## **7.5 Protect Root Anchorage from Damage**

7.5.1 The lignified roots on stone walls are vital for root anchorage. Damage or decay of these roots, particularly those structural roots near the trunk base and those having penetrated into the walls, would weaken the root anchorage and stability of stonewall trees.

7.5.2 Damage to these roots should be avoided and treatment on exposed wounds, such as fungicide, should be promptly applied for effective control against decay or infection. Removal of the joint filler embedding the roots growing on the retaining walls to relieve the roots from girdling should be considered. Where soil nails have to be installed in slope stabilisation works, they should be carefully located to minimise damage to the root anchorage. During construction, tree protection zones (TPZs) should be provided to cater for the roots behind and in front of the stone retaining walls.

## **7.6 Create Rooting Areas at Toe and Crest of Retaining Walls**

Paved areas should be opened up where practicable by creating rooting areas at toe and crest of retaining walls, as it can improve water and nutrient supply and thus encourage root growth which will as a result provide extra physical support to the stonewall trees. Therefore, there should be no sealing of joints unnecessarily and in particular, at the toe of walls.



**Photo No. 6** – Provision of rooting areas at the toe of the retaining wall



**Photo No. 7** – Provision of rooting areas at the crest of the retaining wall

### **7.7 Install Tree Support System**

Tree support system, which in general includes cabling, bracing, propping and guying, should be installed as appropriate taking into account the tree dynamics and practicality of installing these systems.

### **7.8 Integrated Pest Management (IPM)**

7.8.1 Pest problems should be addressed by IPM through appropriate physical, biological, cultural or chemical methods.

7.8.2 If signs and symptoms of the Brown Root Rot (BRR) disease infection are identified, a report should be made to the TMO. Special treatment on trees infected with the BRR disease should be carried out in accordance with the prevailing guidelines promulgated by the TMO such as the “Guidelines on

Brown Root Rot Disease” which is available at [www.trees.gov.hk](http://www.trees.gov.hk).

## **7.9 Protection of Stonewall Trees during Construction**

7.9.1 TPZs during construction should cover the entire wall structure, the stonewall trees, exposed roots and adequate volume of undisturbed aft-soil. The TPZ, where practicable, should consist of (a) the back root protection zone (i.e. area behind the wall), (b) the front root protection zone (i.e. area in front of the wall), and (c) stem protection zone. A tree specialist with good knowledge and experience on stonewall trees preservation should advise on the extent of the TPZ.

7.9.2 Cordon hoarding should be erected around the TPZ and construction activities that are harmful to stonewall trees must be prohibited unless adequate protection arrangements agreed by the tree specialist are put in place. The implementation of tree protection measures should be closely monitored on site throughout the construction period.

7.9.3 Damage to stems and roots of stonewall trees should be avoided during the upgrading of masonry walls through appropriate design measures and close supervision during construction.

## **7.10 Tree Removal**

7.10.1 In a situation where there is a high risk of tree failure that threatens public safety and no appropriate remedial measures are available, the tree should be removed in a timely manner to reduce the risk to an acceptable level.

7.10.2 Removal of stonewall trees should follow proper procedures. The



TMO should be notified beforehand and the removal operation should be properly documented with photo records and provided for the TMO's reference.

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